Alex Gu
Senior

Hobbies
Piano, classical music, fish, chess, running, biking, catan

Clubs
Math team, physics club, programming club, chemistry club, track and field team, chess club

Experience
USAPhO-Plus (2021), PUPC Silver (2021), USAMO (2022), USAJMO Honorable Mention (2020), USACO Platinum

Autobiography
Like many, I started off my journey through competition math: AMC, MathCounts, and all that. And although I do enjoy math for its own sake—exciting problem solving through logic, reasoning, and creativity—I began to find even greater pleasure in physics.

I didn't start learning physics until freshman year, but I seemed to pick it up fairly rapidly. Probably my mathematical background gave me the necessary physical intuition to quickly connect mathematics to the real world. Working through physics problems, I realized that the problem-solving skills I gained from mathematics were way more impactful than I originally thought. After applying intuition to understand a problem, the rest is often simply mathematics, and tricks used to simplify expressions are often key to gaining insight into the phenomena. Indeed, as Wigner puts it, "The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve."

As I continued to study other areas of physics—thermodynamics, E&M, relativity, quantum, etc.—my appreciation for physics grew with my breadth of understanding. Concepts relevant to one phenomenon just kept coming back in analogous ways when studying other seemingly disparate phenomena. The way that all these ideas and laws in different areas remain consistent and intertwined with each was truly beautiful. And that these ideas could be expressed so concisely through the language of mathematics—it was too perfect!

Exploring olympiad physics, I observed the lack of rigor compared to olympiads in math. When learning physics at first, I would frequently try to rigorously work through my ideas and prove to myself why some assumption was undeniably true. Although this approach was certainly essential to gaining a more nuanced understanding, relaxing these constraints opened up avenues for more creativity. In physics, we have the tools of reasoning by analogy, making approximations, and extrapolating equations without full justification. Of course, the eventual formalism is important, but I loved this new way of thinking, through connecting ideas and being more flexible.

One thing I love about physics is how it spawns fundamental philosophical questions about the nature of the world. Do quantities like energy actually exist, or are they just a mathematical construct? And why

are the laws of physics the way they are? As I delved into more foundational physics, I discovered formulations like the principle of least action greatly simplify the “axioms” down to the bare minimum. Yet unlike mathematics where it makes sense to set certain axioms, I remained in wonder at the origin behind our “axioms” in physics.

I would like to express my great appreciation for Dr. Cao, who first introduced me to the wonderful world of physics, providing clear intuition in fundamentals. I am also extremely grateful to my physics teacher, Mr. Naumann, for his continued guidance in my physics journey as well as his support and dedication to the physics community at my school. Finally, I would like to thank my parents for their encouragement and for the resources they have provided me.